GATEWAY DEVICE HAVING AN XML INTERFACE AND ASSOCIATED METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority from the U.S. provisional patent application bearing application number 60/161,181 filed October 22, 1999 by Joel E. Short, et al., the contents of which are incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates generally to a network gateway device and, more particularly, to a network gateway device having an XML interface for communicating with external devices, such as billing and content servers, via XML commands and responses.

BACKGROUND OF THE INVENTION

In order to connect the computer of a user/subscriber to one or more networks or other online services, a variety of gateway devices have been developed. For example, one advantageous gateway device is described by United States Patent Application No. 08/816,174 and United States Provisional Patent Application No. 60/111,497, the contents of both of which are incorporated herein by reference. The gateway device can serve as a gateway to the Internet, an enterprise network, or other networks and/or on-line services. In addition to serving as a gateway, the gateway device can automatically adapt to the protocols and other parameters utilized by the host computer, in order that the host computer may communicate with the network in a manner that is transparent both to the user/subscriber and the network. Once the gateway device has appropriately adapted to the packets coming from the user's computer, the computer can appropriately communicate via the network, such as the network at a hotel, at home, at an airport, or any other location, in order to access other networks, such as the enterprise network, or other online services, such as the internet. In this fashion, the gateway device is capable of providing more efficient network access and network maintenance to the user/subscriber and the network operator.

Gateway devices must therefore communicate with a variety of external devices. For example, gateway devices typically communicate with billing and content servers which present customizable billing options and content pages for every subscriber of the gateway device. With respect to content, billing and content servers can present different log-on screens and pricing to a subscriber based upon one or more attributes associated with the subscriber. For example, a billing and content server can present different log-on screens and pricing based upon the location from which the subscriber accesses the network. In this regard, a subscriber in a suite may be presented with a different log-on screen and pricing options than a subscriber in a regular room or a conference room. Additionally, billing and content servers can present subscribers with customized web content based upon one or more attributes associated with the subscriber. By way of example, a billing and content server can customize the web content based upon the location from which the subscriber accesses the network. In this respect, different fire escape route maps can be presented to the subscriber based upon the room location from which the subscriber accesses the network. Additionally, guests in suites may have access to different web content than subscribers residing in a standard room.

With respect to billing, billing and content servers typically interface with a credit card authorization server in order to obtain credit card information and authorization regarding the various subscribers. Depending upon the billing arrangement of a particular subscriber, the billing and content server can communicate directly with the credit card authorization service in order to appropriately charge the subscriber's credit card account for the various services that the subscriber accesses via the gateway device. Alternatively, the billing and content server can communicate via the gateway device with a network management system, such as the property management system of a hotel, in order to appropriately charge the subscriber's account for the various services that the subscriber accesses via the gateway device.

Billing and content servers can also perform other functions, such as distributing email based upon mailing lists configured according to subscriber-specific information. Billing and content servers can also maintain and update membership records, such as frequent users clubs or frequent visitors clubs.

As briefly mentioned above, gateway devices may also communicate with a network management system, such as the property management system maintained by a hotel or the like. The functions performed by a network management system typically vary based upon the installation and application. For example, typical hotel property management systems automate operations such as room reservations, room assignments, guest check-in and check-out, and other front desk activities. Furthermore, typical hotel property management systems can maintain a log of telephone calls and telephone charges for each guest room, and can be in communication with the Internet to facilitate on-line reservations. As described in a provisional application entitled *Systems And Methods For Enabling Network Gateway Devices To Communicate With Management Systems To Facilitate Subscriber Management* bearing application number 60/160,973 filed October 22, 1999 and in a utility patent application entitled *Systems and Methods for Integrating A Network Gateway Device with Management Systems* filed concurrently herewith, gateway devices oftentimes communicate with network management systems, such as in instances in which the subscriber's access to various networks or on-line services is to be charged to their account that is administered by the network management system. The contents of these applications are also incorporated herein by reference.

Upon requesting access to a particular computer system or on-line service, the gateway device typically determines if the subscriber is entitled to access the computer system, the level of access and/or the type of services to which the subscriber is entitled according to an Authentication, Authorization, and Accounting (AAA) procedure that is described by U.S. Patent Application No. 09/458,602 entitled *Systems and Methods for Authorizing, Authenticating and Accounting Users Having Transparent Computer Access to a Network Using a Gateway Device* filed December 8, 1999 and a patent application entitled *Systems and Methods for Providing Dynamic Network Authorization, Authentication and Accounting* filed concurrently herewith, the contents of each of which are incorporated herein by reference. An AAA server, which is a database of subscriber records, may be remote to the gateway device or the AAA database may be incorporated into the physical embodiment housing the gateway device. As such, in instances in which the AAA server is remote to the gateway device, the gateway device must also frequently communicate with the AAA server.

In addition to the external devices described above with which the gateway device frequently communicates, gateway devices may also communicate with a wide variety of other external devices depending upon the application. Unfortunately, communications with any of these external devices may be limited due to the particular format in which the external devices are designed to transmit and receive information. Since the external devices are typically designed by a number of different vendors, each of which may prefer a different format for communications, this problem is compounded by the lack of uniformity in the format with which the external devices communicate. In this regard, one external device may be designed to communicate according to one format, while another external device may be required to communicate according to another format. Since the subscriber gateway may be required to communicate with a variety of different external devices, the gateway device would seemingly have to communicate with each external device according to the particular format that is acceptable to the external device. This requirement can quickly prove cumbersome to the design, implementation and efficient operation of a gateway device since it will be forced to communicate according to a number of different formats. While this requirement is a current concern for the efficient utilization of gateway devices that must communicate with multiple external devices, this concern is expected to grow as the variety of applications in which gateway devices are employed increases and the number of different types of external devices with which the gateway device must communicate also grows.

SUMMARY OF THE INVENTION

According to the present invention, a gateway device and associated method are therefore provided that facilitate communications with external devices by utilizing a uniform communications format. As such, the gateway device is not required to communicate with each external device according to a unique format defined by the respective external device. Accordingly, the gateway device and associated method of the present invention improve communications between the subscriber computer, gateway device and various external devices, such as billing and content servers, property management systems, external AAA servers and the like.

According to one aspect of the present invention, a gateway device is provided that includes a subscriber interface for adapting to a subscriber computer that is connected to the gateway device. The subscriber interface facilitates communications between the subscriber computer and at least one network or on-line service without requiring the subscriber computer to be reconfigured and, in particular, without requiring the subscriber computer to support XML commands and responses. According to the present invention, the gateway device also includes an XML interface for communicating with an external device via a series of XML commands and responses. The XML commands and responses can relate to a variety of matters, including various subscriber management matters.

Typically, the XML interface includes a parser front end, a parser section and a building section for appropriately handling XML commands that are received by the gateway device and for sending appropriate responses. The parser front end determines the type of operation requested by the external device. The parser section is responsive to the parser front and organizes elements parsed from either an XML command or an XML response. Once parsed, the XML command is executed. Typically, the parser section passes at least some of the elements to a requested application. Prior to passing the elements to a requested application, however, the parser section typically nests the elements to be passed within an application programming interface (API) wrapper. The building section prepares responses to requests received by the gateway device. Typically, the building section assembles results returned by requested application into an XML response. The gateway device of the present invention can also include an internal web server for communicating with both the XML interface and the internet to thereby facilitate XML-based communications between the gateway device and external devices connected to the internet. As such, the gateway device supports communications involving the subscriber computer and the external devices without ever requiring the subscriber computer to support XML commands and responses.

The present invention also provides a method for communicating between the gateway device and external device via the internet. According to this aspect of the present invention, an XML command is initially received at the gateway device from the external device, such as the billing and content server. The XML command is then

parsed, and the parsed XML command is executed, such as by being passed to a respective application program, such as the AAA server for performing the requested function, such as a subscriber management function. Prior to passing the parsed XML command to the respective application program, however, the elements to be passed to the requested application are preferably nested within an API wrapper. Upon completion of the requested function, the application program issues a response that is received by the gateway device and that is then included within an XML response transmitted from the gateway device to the external device.

As such, the gateway device and associated method of the present invention facilitate communications between the subscriber computer, the gateway device and a variety of external devices, such as external billing and content servers, property management systems and external AAA servers. In this regard, the gateway device can communicate with each of these various external devices in a uniform manner via a series of XML commands and responses, thereby dramatically reducing, if not eliminating, the instances in which the gateway device would have to communicate with an external device according to the unique format established by the external device. As a result, the design, implementation and operation of the gateway device should be considerably simplified. However, the gateway device and associated method of the present invention permit the subscriber computer to enjoy the benefits of the common XML command and response format without ever having to be reconfigured to support XML.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram of a computer system that includes a gateway device for facilitating communications between one or more computers and various other networks or on-line services in a manner that is transparent to both the user/subscribers and the network administrators and internet service providers.

Figure 2 is a block diagram illustrating the format and protocol of messages transmitted to and from a gateway device according to one embodiment of the present invention, including messages transmitted between the gateway device and a billing and content server.

Figure 3 is a block diagram illustrating an XML interface of a gateway device according to one embodiment of the present invention, as well as the various devices with which the XML interface communicates.

Figure 4 is a stack representation of the XML interface of Figure 3 as well as the various devices with which the XML interface communicates so as to illustrate the relative hierarchy between the respective devices.

DETAILED DESCRIPTION OF THE INVENTION

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

Referring now to Figure 1, there is shown in block diagram form a computer system **10** including a plurality of computers **14** that can communicate with one or more online services **22** or networks via a gateway device **12** that provides the interface between the computers and the various networks **20** or online services. One embodiment of such a gateway device has been described in U.S. Patent Application No. 08/816,174 and U.S. Provisional Application No. 60/111,497 (collectively referred to herein as the Gateway Device Applications), the contents of which have been incorporated herein by reference. Briefly, the gateway device facilitates transparent computer access to the online services or networks, such that the computers can access any networks via the gateway device regardless of their network configurations. The gateway device includes a subscriber interface that adapts to the computer of a user to facilitate communication between the computer and a network or other online service without requiring the computer to be reconfigured. In this regard, the subscriber interface of the gateway device has the ability to recognize computers attempting to access a network, the location of computers attempting to access a network, the identity of users attempting to gain

network access, and additional attributes, as is discussed in the Gateway Device Applications.

As illustrated in Figure 1, the computer system **10** also includes an access concentrator **16** positioned between the computers **14** and the gateway device **12** for multiplexing the signals received from the plurality of computers onto a link to the gateway device. Depending upon the medium by which the computers **14** are connected to the access concentrator, the access concentrator **16** can be configured in different manners. For example, the access concentrator can be a digital subscriber line access multiplexer (DSLAM) for signals transmitted via regular telephone lines, a cable head end (a Cable Modem Termination Shelf (CMTS)) for signals transmitted via coaxial cables, a wireless access point (WAP) for signals transmitted via a wireless network, a switch or the like.

The computer system **10** further includes one or more routers **18** and/or servers (not shown in Figure 1) to control or direct traffic to and from a plurality of computer networks **20** or other online services **22**. While the computer system is depicted to have a single router, the computer system can have a plurality of routers, switches, bridges, or the like that are arranged in some hierarchical fashion in order to appropriately route traffic to and from the various networks or online services. In this regard, the gateway device **12** typically establishes a link with one or more routers. The routers, in turn, establish links with the servers of the networks or online services, based upon the user's selection. It will be appreciated by one of ordinary skill in the art that one or more devices illustrated in Figure 1 may be combinable. For example, although not shown, the router may be located entirely within the gateway device. Furthermore, additional elements may be included in the computer system, such as elements disclosed in the Gateway Device Application, or network elements known to those of ordinary skill in the art.

As described above, gateway devices **14** must typically communicate with a variety of external devices. For example, gateway devices typically communicate with billing and content servers **26** as depicted in Figures 1 and 2. As also described above, billing and content servers present customized billing options and content pages for every

subscriber of a gateway device. As such, gateway devices must communicate on a frequent basis with the billing and content server.

The gateway device **12** may also communicate with a management system **28**, such as the property management system of a hotel or the like. In this regard, Figure 2 shows a block diagram of the computer system of Figure 1, integrated with a hotel computer system, according to one embodiment of the present invention. It will be appreciated by those of skill in the art that the embodiment shown in Figure 2 is for illustrative purposes, and that the computer system may be integrated with virtually any network or network management system, such as computer networks established in corporate offices, airports, arenas, apartment complexes, office buildings or the like. As a result, the embodiment shown in Figure 2 is for illustrative purposes only, and is not intended to limit the scope of the present invention.

While the functions performed by network management systems **28** vary based upon the installation and the application, typical hotel property management systems automate operations such as room reservations, room assignments, guest check-in and check-out and other front desk activities as described above. In addition, typical hotel property management systems can maintain a log of telephone calls and telephone charges for application to the bill for each guest room. Accordingly, the gateway device **12** of the present invention can communicate with a property management system in order to place charges for the various services that a subscriber accessed via the gateway device upon the appropriate bill that is maintained by the property management system.

Moreover, while the AAA functionality is typically physically embodied within the gateway device **12**, the gateway device can be configured to communicate with external AAA servers in order to authenticate a subscriber, to obtain authorization for the services requested by the subscriber and to appropriately account for their usage. In addition, gateway devices may communicate with a wide variety of other external devices, particularly as gateway devices are deployed in new applications or installations.

In order to avoid the overhead associated with communicating with each of these external devices according to the unique format in which the external device is designed to communicate, the gateway device **12** of the present invention communicates with the external devices with a series of commands and responses formatted according to the

extensible markup language (XML). As known to those skilled in the art, XML is defined as an application profile of the standard generalized markup language (SGML) that is defined by ISO 8879. While SGML has been the standard, vendor-independent technique to maintain repositories of structured documentation for more than a decade, SGML is not well suited to serving documents over the world wide web. While XML is designed to enable the use of SGML on the world wide web, XML is not a single, predefined markup language. Instead, XML allows the system designer to design their own markup language. In this regard, a predefined markup language, such as hypertext markup language (HTML), defines one manner in which to describe information in one specific class of documents. In contrast, XML allows the system designer to define its own customized markup languages for different classes of documents. As such, XML specifies neither semantics nor a tag set. However, XML provides a facility to define tags and the structural relationships between them. See XML specification 1.0 for further details regarding XML.

XML has conventionally been utilized to facilitate communications between servers, such as for billing purposes, and not to facilitate communications with a user, either directly with a user's computer **14** or through an intermediary such as a gateway device **12**. As such, computers are not generally configured to communicate in or to support XML. In order to provide a user with the advantages of XML including the ability to communicate in a common language with a wide variety of network devices without requiring that each computer be reconfigured to support XML, the gateway device **12** of the present invention serves as a proxy for the user's computer and utilizes XML to communicate with a variety of external devices, including the billing and content server **26** and the property management system **28**. In addition, in instances in which the AAA functionality resides in an external AAA server, the gateway device can also communicate with the external AAA server via XML. In particular, the gateway device is designed to communicate with the network devices according to a set of XML commands and XML responses, thereby affording the user's computer the advantages offered by XML without requiring the user's computer to be reconfigured to support XML. Since the XML format is not specific to any particular external device, the gateway device can advantageously communicate with a variety of external devices via a

common format, i.e., XML, and need not format messages differently based upon the format with which the external device is otherwise designed to communicate.

For example, a user can submit a request to purchase a product from an online provider. According to the present invention and as described in the following examples, the gateway device **12** can then communicate in a common XML format with various network devices, including billing and content servers, to authenticate and authorize the user, to order the product and to account for the user's payment for the product, without ever requiring the user's computer **14** to support XML.

As depicted in Figure 3, the gateway device **12** typically includes an internal web server **30** that processes HTTP streams that are received from external devices. In instances in which the external device and the gateway device will communicate via the XML protocol, the HTTP string will have XML as the content type, while the content itself will consist of tags, attributes and data. As known to those skilled in the art, tags serve as field identifiers and attributes contain the values of input parameters that are used as record keys or search arguments, i.e., a MAC address. In addition, data elements are values that are to be stored in the tables and authorization files of the gateway device. Data is also returned in response streams sent by the gateway device to the external devices.

In order to handle XML commands that are received from an external device, the gateway device **12** includes an XML interface, also known as an XML parser **32**, that is typically comprised of software, that is compliant with the world wide web consortium (W3C) standards to validate the XML command strings and the attributes and data derived from an XML query string. As depicted in Figure 3, an XML interface typically includes a parser front end **34** that is also typically comprised of software and that invokes the core of a parser and determines the type of operation being requested. For example, in one common embodiment, the gateway device will receive an XML command from the billing and content server **26** requesting a specific AAA operation. As such, the following description of the XML interface as well as accompanying Figures 3 and 4 will be in terms of XML commands from the billing and content server requesting an AAA operation. However, the XML interface can facilitate XML-based communications between a wide variety of other devices without departing from the

spirit and scope of the present invention. In this regard, the only requirement is that the external device has an XML interface, i.e., an XML parser, and be adapted to support the same XML command protocol as the gateway device. One example of an XML protocol for communications between a gateway device and a billing and content server is provided below, although other XML command protocols can be established without departing from the spirit and scope of the present invention.

The XML interface **32** of the gateway device **12** also includes a parser section **36**, typically comprised of software, to handle elements as they are parsed from the XML stream. In this regard, parsed elements are organized into separate parameters that are passed to the requested application, such as the AAA server, via an appropriate application program interface (API). As shown in Figure 3, the sets of parameters that are to be passed to the requested application are typically nested inside or wrapped within a record structure having an appropriate protocol as indicated by block **38** designated as the API "wrapper", that also provides any necessary translation of data elements, e.g. those that need to be converted from string format to some numeric format for internal processing reasons. Once properly wrapped, the sets of parameters are passed via the appropriate API **40** to the requested application, such as the AAA **42**. The requested application then responds to the request and provides the requested data via the API to the XML interface of the gateway device.

The gateway device **12** therefore also includes a building section **44** that is also comprised of software and that prepares responses to requests received by the gateway device. In this regard, the building section of the XML interface **32** assembles the results returned by the requested application into a new XML string that will be part of the HTTP response stream returned to the external device via a component such as the aforementioned goahead server. With respect to a HTTP response stream sent back to a billing and content server **26** via the world wide web, the HTTP response stream is typically nested inside a TCP/IP packet in order to be appropriately transmitted and received by the billing and content server. See, for example, Figure 2 that depicts the relative protocols and formats for signals transmitted between different elements of the overall computer system **10**. However, other protocols can be utilized without departing from the spirit and scope of the present invention.

A response that is returned by the gateway device **12** can be one of two types. First, a standard "OK" response can be returned that typically includes the data, if any, requested by the external device. Alternatively, an error response can be returned that typically consists of a numeric error code and a textual description of the error. In either instance, the XML interface **32** generally creates a standard header consisting of the status, such as "OK" or "ERROR", the ID of the gateway device and the gateway device's IP address. This response is then placed onto the world wide web by the internal web server **30** of the gateway device for delivery to the external device.

While the XML interface **32** of the gateway device **12** of the present invention will be primarily described hereinafter in conjunction with XML commands received by the gateway device from an external device, followed by XML responses sent by the gateway device to the external device, the gateway device of the present invention can be constructed so as to initiate XML-based communications by issuing XML commands to various external devices and awaiting appropriate responses. In addition, while the gateway device including an XML interface will primarily be described in conjunction with communications involving an external billing and content server **26** that requests information from the AAA server, the gateway device can establish XML-based communications with other external devices, such as a property management system **28** or, in instances in which the AAA server is external to the gateway device, with the AAA server itself. In any of these instances, the gateway device is able to communicate with the external device or server according to a common protocol, i.e., XML, without having to communicate with each external device in the format unique to the respective external device. As such, the only requirement of the external device is that the external device has an XML interface and be adapted to support the same XML command protocol as the gateway device.

While various XML command protocols can be established depending upon the external device and the nature of the communication between the external device and the gateway device **12**, one command protocol established between an external billing and content server **26** and a gateway device is hereinafter provided by way of example and not by way of limitation. In this example, the billing and content server sends XML commands to the gateway device which, in turn, responds to the billing and content

server. In one example, the XML commands transmitted by the billing and content server to the gateway device are sent using an HTTP form POST in which the information is placed in packets sent after the HTTP header. In this example, the command text will generally follow the following format:

```
<USG COMMAND="(command)" [(attr)="(attr_data)"]>
   <(tag_n) [tag_n_attr = "(tag_n_attr_data)"]>(data_n)</(tag_n)>
 </USG>
```

where: (**command**) is a gateway device command;
(**attr**) is an optional attribute associated with a command;
(**attr_data**) is the data associated with the optional attribute tag;
(**tag_n**) is a data name tag used for specifying command parameter names;
(**tag_n_attr**) is an optional attribute name tag;
(**tag_n_attr_data**) is optional attribute data, and
(**data_n**) is the data associated with a data name tag.

In addition, the typical XML response from the gateway device **12** to a billing and content server **28** following receipt of an XML command from the billing and content server is typically formatted as follows:

HTTP/1.1 200 OK	(specifies request understood)
Server: UI 3A4B6D	(use the gateway device ID as the server name)
Date: Fri, 23 Jul 1999 00:09:55 GMT	(current date/time)
Content-Type: text/xml	(specifies XML content)
Last-Modified: Fri, 23 Jul 1999 00:09:55 GMT	(current date/time)
Content-Length: 560	(size of message body in characters)
	(this must be a blank line)
(series of XML tag/data pairs)	
	(end of message body)

In this regard, while the series of XML tag/data pairs referenced in the above exemplary XML response format will depend upon the particular command as described below, one series of XML tag/data pairs typically follow the following format:

```
<USG RESULT="(RESULTCODE)" ID="(UI)" IP="(USG_IP_ADDR)">
      [<ERROR_NUM>(error number)</ERROR_NUM>]
      [<ERROR_DESC>(error description)</ERROR_DESC>]
      <(tag_n) [tag_n_attr = "tag_n_attr_data"]>(data_n)</(tag_n)>
</USG>
```

where: (`RESULTCODE`) is either "OK" or "ERROR";
(`UI`) is the gateway device ID;
(`USG_IP_ADDR`) is the IP address of the gateway device;
(`tag_n`) is a data name tag;
(`tag_n_attr`) is an optional attribute name tag;

(tag_n_attr_data) is optional attribute data; and
(data_n) is the data associated with a data name tag.

As indicated, all XML responses returned following an XML command will contain error information. In this regard, the attribute RESULT will be assigned either "OK" or "ERROR". If an error did occur, two additional tag/data pairs will be added as part of the response form, namely, error_num and error_desc. The error number data will contain an integer number representing the error that occurred, while the error description data will be a readable textual description of the error.

While a variety of commands and responses can be established based upon the foregoing XML command and response formats, examples of several particular commands that could be issued by a billing and content server **26** to the gateway device **12**, requesting either room administration or user administration, are provided below. The resulting responses provided by the gateway device are also provided. However, the following commands and responses are for purposes of illustration only and should not be construed as limitations of the type of XML commands and responses that can be formulated.

Regarding room administration, the billing and content server **28** can issue an XML command to set the access mode of a specified room that includes the following command, command attribute, command attribute data, and tag/data pair:

Command:	"**ROOM_SET_ACCESS**"
Command attr:	"**ROOM_NUMBER**"
Command attr_data:	Room number (8 char. max string)
tag_1:	"**ACCESS_MODE**"
data_1:	"**ROOM_OPEN**", "**ROOM_CHARGE**", or "**ROOM_BLOCK**"

In response, the gateway device **12** would typically issue a standard XML response indicating that the command was received and implemented appropriately or that an error occurred.

Also with respect to room administration, a billing and content server **26** can issue a command querying the gateway device **12** regarding the access mode of a specified room. In this regard, the query room status command could include the following command, command attribute, and command attribute data:

Command: "**ROOM_QUERY_ACCESS**"

Command attr: "ROOM_NUMBER"
Command attr_data: Room number (8 char. max string)

In response, the gateway device **12** could return a standard response, including the following tags and data in which the room access mode is selected from one of "room_open", "room_charge" or the "room_block":

tag_1 = "ROOM_NUMBER"
data_1 = (room number)
tag_2 = "ACCESS_MODE"
data_2 = (room access mode)

With respect to user administration, the billing and content server **26** can issue a command to add or update a user that has been authorized for access and should now be added to the MAC or some other type of authorization table, that is, a memory table maintained by the gateway device **12**. In this regard, one example of an XML command to add/update a user typically includes the following command, command attribute, command attribute data, and tag/data pair:

Command: "USER_ADD"
Command attr: "MAC_ADDR"
Command attr_data: user MAC address (string)
tag_1: "USER_NAME"
data_1: (user name)
tag_2: "PASSWORD"
tag_2_attr: "ENCRYPT"
tag_2_attr_data: "TRUE" or "FALSE"
data_2: (user password)
tag_3: "EXPIRY_TIME"
tag_3_attr: "UNITS"
tag_3_attr_data: "SECONDS", "HOURS", "DAYS"
data_3: (number of expiry units)
tag_4: "ROOM_NUMBER"
data_4: (user's room number)
tag_5: "PAYMENT_METHOD"
data_5: "RADIUS", "PMS", "CREDIT_CARD", or "ROOM_OPEN"
tag_6: "CONFIRMATION"
data_6: (confirmation code/ID)
tag_7: "PAYMENT"
data_7: (amount paid for access)

In response, the gateway device **12** would typically issue a standard XML response indicating that the command was received and processed appropriately or that an error occurred.

The billing and content server **26** can also issue an XML command to delete a user who is identified by a Subscriber Identifier, such as a MAC address, a user name or an IP address. In this regard, one example of a delete user command typically includes the following command, tag and data:

Command:	"**USER_DELETE**"
tag_1:	"**USER**"
tag_1_attr:	"**ID_TYPE**"
tag_1_attr_data:	"**MAC_ADDR**", "USER_NAME" OR "IP_ADDR"
data_1:	if **ID_TYPE** = "**MAC_ADDR**" then (user MAC address) if **ID_TYPE** = "**USER_NAME**" then (user name) if ID_TYPE = "IP_ADDR" then (user IP address)

In response, the gateway device **12** would typically issue a standard XML response indicating that the command was received and processed appropriately or that an error occurred.

The billing and content server **26** can also query the gateway device **12** for the current user data by issuing an XML command that, in one example, includes the following command, tag and data:

Command:	"**USER_QUERY**"
tag_1:	"**USER**"
tag_1_attr:	"**ID_TYPE**"
tag_1_attr_data:	"**MAC_ADDR**", "**USER_NAME**" or "IP_ADDR"
data_1:	if **ID_TYPE** = "**MAC_ADDR**" then (user MAC address) if **ID_TYPE** = "**USER_NAME**" then (user name) if ID_TYPE = "IP_ADDR" then (user IP address)

In response, the gateway device **12** typically uses a standard XML response with the following tags/data pairs:

tag_1:	= "**MAC_ADDR**"
data_1:	= (user MAC address)
tag_2:	= "**USER_NAME**"
data_2:	= (user name)
tag_3	= "IP_ADDR"
data_3	= (user IP address)
tag_4:	= "**PASSWORD**"

data_4:	= (user password)
tag_5:	= "**EXPIRY_TIME**"
tag_5_attr:	= "**UNITS**"
tag_5_attr_data:	= "**SECONDS**", "**HOURS**", "**DAYS**"
data_5:	= (number of expiry units)
tag_6:	= "**ROOM_NUMBER**"
data_6:	= (user's room number)
tag_7:	= "**PAYMENT_METHOD**"
data_7:	= "**RADIUS**", "**PMS**", "**CREDIT_CARD**", "**ROOM**"
tag_8:	= "**DATA_VOLUME**"
data_8:	= (data transferred by user in Kbytes)

The billing and content server **26** can also issue a command to check a user's identity, as specified by a MAC address, as one example, against the authorization tables maintained by the gateway device **12** or the associated AAA server. If the user is found either in the MAC or room authorization table of this example, VALID_USER is returned along with the user authorization method, such as RADIUS, property management system (PMS) (in instances in which the fee is to be billed to the user's account), credit card or room (in instances in which the room is opened up for free internet access). If the user was not found in the MAC or room authorization tables, INVALID_USER will be returned. In any event, the XML command issued by the billing and content server typically includes the following command, command attribute and command attribute data:

Command:	"**USER_AUTHORIZE**"
Command attr:	"**MAC_ADDR**"
Command attr_data:	user MAC address (string)

In response, the gateway device **12** typically issues a standard XML response indicating that the command was received and processed appropriately or that an error occurred, and that includes the following tag and data pairs:

tag_1:	= "**STATUS**"
data_1:	= "**VALID_USER**" or "**INVALID_USER**"
tag_2:	= "**PAYMENT_METHOD**"
data_2:	= "**RADIUS**", "**PMS**", "**CREDIT_CARD**", or "**ROOM**"

The billing and content server **26** can also issue an XML command requesting user authorization and payment. If the authorization method that the user has selected is

RADIUS, then the gateway device **12** will establish communication with the RADIUS server, authenticate the user, charge the user's account, and return the result of the authorization to the billing and content server. If the authorization method chosen by the user is PMS, the gateway device will establish communication with the PMS **28**, authenticate the user, have an access fee added to the user's room bill, and return the result of the authorization to the billing and content server. In either event, the XML command issued by the billing and content server to request user authorization payment includes the following command, command attribute, command attribute data and tag and data pairs:

Command:	"USER_PAYMENT"	
Command attr:	"PAYMENT_METHOD"	
Command attr_data:	"RADIUS" or "PMS"	
tag_1:	"USER_NAME"	
data_1:	(user name)	
tag_2:	"PASSWORD"	
tag_2_attr:	"ENCRYPT"	
tag_2_attr_data:	"TRUE" or "FALSE"	
data_2:	(user password)	
tag_3:	"EXPIRY_TIME"	- only if METHOD="PMS"
tag_3_attr:	"UNITS"	
tag_3_attr_data:	"SECONDS", "HOURS", "DAYS"	
data_3:	(number of expiry units)	- only if METHOD="PMS"
tag_4:	"ROOM_NUMBER"	
data_4:	(user's room number)	
tag_5:	"PAYMENT"	- only if METHOD="PMS"
data_5:	(amount charged for access)	- only if METHOD="PMS"

In response, the gateway device **12** issues a standard XML response indicating that the command was received and processed appropriately or that an error occurred, and that includes the following tag and data:

tag_1:	= "CONFIRMATION"
data_1:	= (confirmation number/ID)

The billing and content server **26** can also issue an XML command in instances in which a user makes an e-commerce or special service purchase that is to be charged, such as to the user's bill via the property management system **28**. In this regard, the billing and

content server issues an XML command that includes the following command, command attribute, command attribute data and tag and data pairs.

Command:	"USER_PURCHASE"
Command attr:	"ROOM_NUMBER"
Command attr_data:	(room number)
tag_1:	"ITEM_CODE"
data_1:	(item code)
tag_2:	"ITEM_DESCRIPTION"
data_2:	(description of purchase)
tag_3:	"ITEM_AMOUNT"
data_3:	(amount of item with out tax)
tag_4:	"ITEM_TAX"
data_4:	(tax charged on item)
tag_5:	"ITEM_TOTAL"
data_5:	(total amount charged including tax)

In response, the gateway device will issue a standard XML response indicating that the command was received and processed appropriately or that an error occurred.

Finally, the billing and content server 26 can issue an XML command in order to update cache memory by changing the status of an entry in the memory authorization table, as identified by the MAC address by way of example, from "pending" to "authorized". In this regard, the XML command can include the following command, command attribute, command attribute date and tag and data pair:

Command:	"CACHE_UPDATE"
Command attr:	"MAC_ADDR"
Command attr_data:	user MAC address (string)
tag_1:	"PAYMENT_METHOD"
data_1:	"RADIUS", "PMS", "CREDIT_CARD", or "ROOM_OPEN"

In response, the gateway device will issue a standard XML response indicating that the command was received and processed appropriately or that an error occurred.

While the foregoing XML commands and XML responses that would flow between a billing and content server **26** and a gateway device **12** have been provided by way of example in order to illustrate one particular application of the XML interface **32** or XML parser of a gateway device, the gateway device that includes an XML interface according to the present invention can be employed to communicate with the billing and content server according to a wide variety of other commands and responses depending

upon the application. In addition, a gateway device that includes an XML interface can also be employed to communicate with a wide variety of other external devices, including a property management system **28**, an external AAA server, or other external devices. In addition, the gateway device can be configured to issue the XML commands and to receive XML responses if necessary for the particular application. In any event, a gateway device that includes an XML interface facilitates communication between the gateway device and various external devices in a uniform manner, thereby avoiding having to communicate with each of the external devices according to a unique format established by the vendor of the external device. As a result, the design, implementation operation of the gateway device is greatly simplified and the user is able to reap the advantages provided by XML without having to reconfigure their computer **14** to support XML.

Many modifications and other embodiments of the invention will come to mind to one skilled in the art to which this invention pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.